

Air Force Petroleum Agency

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***Military Specification Updates &
Deicing Working Group Initiatives***

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AFPA / PTPT

*Air Force Corrosion Conference
August 18, 2011*

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Military Specification Updates



- **MIL-PRF-27617 – Grease, Aircraft and Instrument, Fuel and Oxidizer Resistant.**
 - **Coordination closed August 6, 2011**
 - **Workmanship requirement has been added**
 - **Type V Grease is now required to pass Liquid Oxygen Impact testing**
- **MIL-PRF-25681 – Lubricant Molybdenum Disulfide, Silicone**
 - **Comments close 29 August 2011**
 - **Modernized for Toxicity, MSDS, and Shelf-Life clauses**
- **MIL-PRF-83261 – Grease, Aircraft, Extreme Pressure, Anti-Wear**
 - **Modernized for Toxicity, MSDS, and Shelf-Life clauses**
- **MIL-PRF-25017**
 - **Wording changed from “Inhibitor” to “Additive” for clarification**
 - **Removed A-A-52557, as Diesel is procured to ASTM D975**



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Revision to MIL-PRF-32014



- It is expected that MIL-PRF-32014 will be revised later in 2011.
- Proposed changes:
 - Change the corrosion prevention requirement to a more suitable test method.
 - Currently in the spec: ASTM D5969 using 5% synthetic sea water
 - Most grease samples are currently failing this requirement. No corrosion reports have been received from the field (AF/Navy).
 - While AFRL/MLBT was the MIL-PRF-32014 Preparer, they considered other more suitable alternatives such as the Corrosion Rate Evaluation Procedure (CREP) but it was never formally proposed.
 - Being proposed: ASTM D6138 Emcor Rust Test using 3% synthetic sea water
 - D6138 takes longer to run (7 days vs. 1 day), combines standing and dynamic testing; more accepted test method for greases in industry than D5969
 - Address other issues, such as the temperature at which ASTM D5706 (SRV Extreme Pressure) should be run at. It is 80°C.



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Revision to MIL-PRF-87937



- It is proposed to revise MIL-PRF-87937 in the next year or so.
- Proposed changes
 - Increase the qualification lifetime from 3 to 5 years
 - Remove Type II cleaning compounds. AFTT decided to phase out Type II compounds while AFPET was at San Antonio TX.
 - Type II compounds were considered as dilute Type IV compounds so it was decided to eliminate from the specification
 - Currently there are no qualified Type II compounds
 - A non-terpene containing Type I (designated as either Type Ib or Type V) has been considered
- Input has been/is requested from AF to ensure that all materials and requirements (including environmental) addressed by MIL-PRF-87937 are properly addressed.



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Environmentally Benign & Reduced Corrosion Runway Deicing Fluid



Partnership with Battelle Memorial Institute (lead agency), AFRL/ ASC, Army (CRREL), Navy (NAVAIR), Octagon, AMIL (University of Quebec)

Developed & evaluated novel chemistry to formulate RDF from inexpensive, bio-based raw materials

- Identified 2-3 runway formulations
- Transesterification of vegetable oils & other fats (Company proprietary polyol(s) & salts)

Performed Demonstration /Validation in Winter 2009-2010

- Performed Comparably to Hazardous Potassium Acetate
- Is environmentally benign
- Reduces / eliminates hazardous potassium acetate
- Reduce corrosion of Cd-plated parts & carbon brakes

Reduced cost RDF discharge/treatment by 50%



Crude
Material



Refined
RDF

Received 2008 Top 100 Inventions Award from R & D Magazine



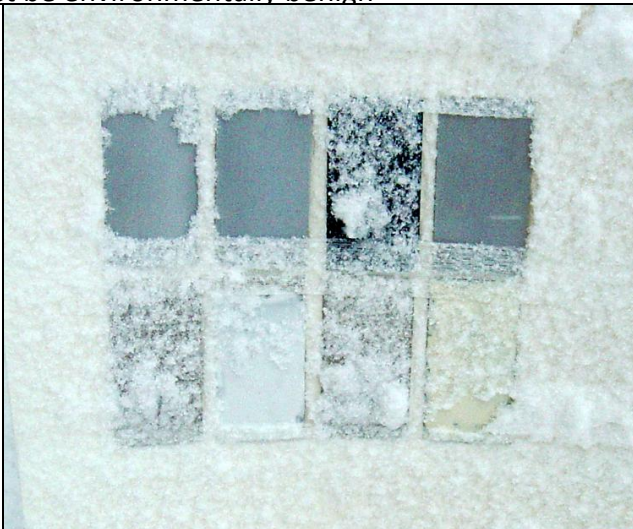
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Novel Aircraft Anti-Ice Coating Material – Seashell Technology



Objective:

- Creation and testing of novel nanocomposite coatings that minimize both ice accretion and adherence to military topcoat surfaces
 - Approach uses ultrahydrophobic additives in coatings and be compatible with existing A/C topcoats (MIL-PRF-85285)
- Demonstrate effectiveness of novel ultrahydrophobic coating formulation for icephobic activity in collaboration with industrial partner (The Goodrich Corporation)
- Must not alter existing A/C topcoat/coating system properties (i.e. optical props, color, surface smoothness)
- Must be environmentally benign

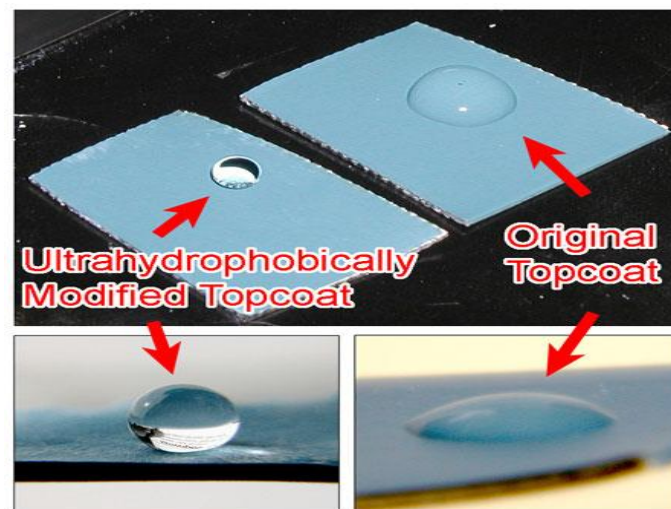


Benefits/Impacts:

- Reduce aircraft surface ice accretion and adhesion due to the “*Lotus effect*”
- Compatible with MIL-PRF-85285 topcoat
- Does not increase drag.
- Does not add substantial weight and easily removed.
- Does not alter paint colors or alter optical properties.
- Is cleanable and repairable.
- Environmentally friendly – reduces need for propylene glycol & other hazardous solvents.

Customer: ALCs, all weapons systems

USAF POC: Dr. Elizabeth Berman



The Air Force Petroleum Agency



Ice-Phobic Clearcoat to Improve Aircraft and Pilot Safety – ePaint



Objective:

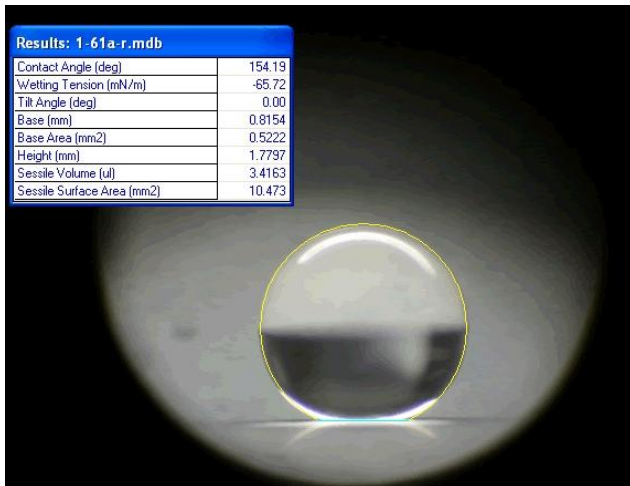
- Develop a novel icephobic topcoat for inhibiting the attachment of ice
 - The system is compatible with current military topcoats (MIL-PRF-85285), and currently used military aircraft colors and optical properties.
- Develop Phase Change Material (PCMs) encapsulated within a thin, flexible, hydrophobic polymer topcoat.
- Formulate PCMs into no-VOC resins for anti-icing application.
- Determine anti-ice and ice adhesion characteristics of test coatings and determine optical transparency of clearcoat.

Benefits/Impacts:

- Reduce current untreated aircraft surface ice formation
- Be easily strippable and be a clear coat
- Elimination of potential runoff from environmentally harmful deicing operations
- Reduction in overall fluid use by 90%
- Elimination of costs associated with capturing runoff
 - \$10K - \$200K per location (varies depending on local wastewater discharge limitations)

Customer: ALCs, all weapons systems

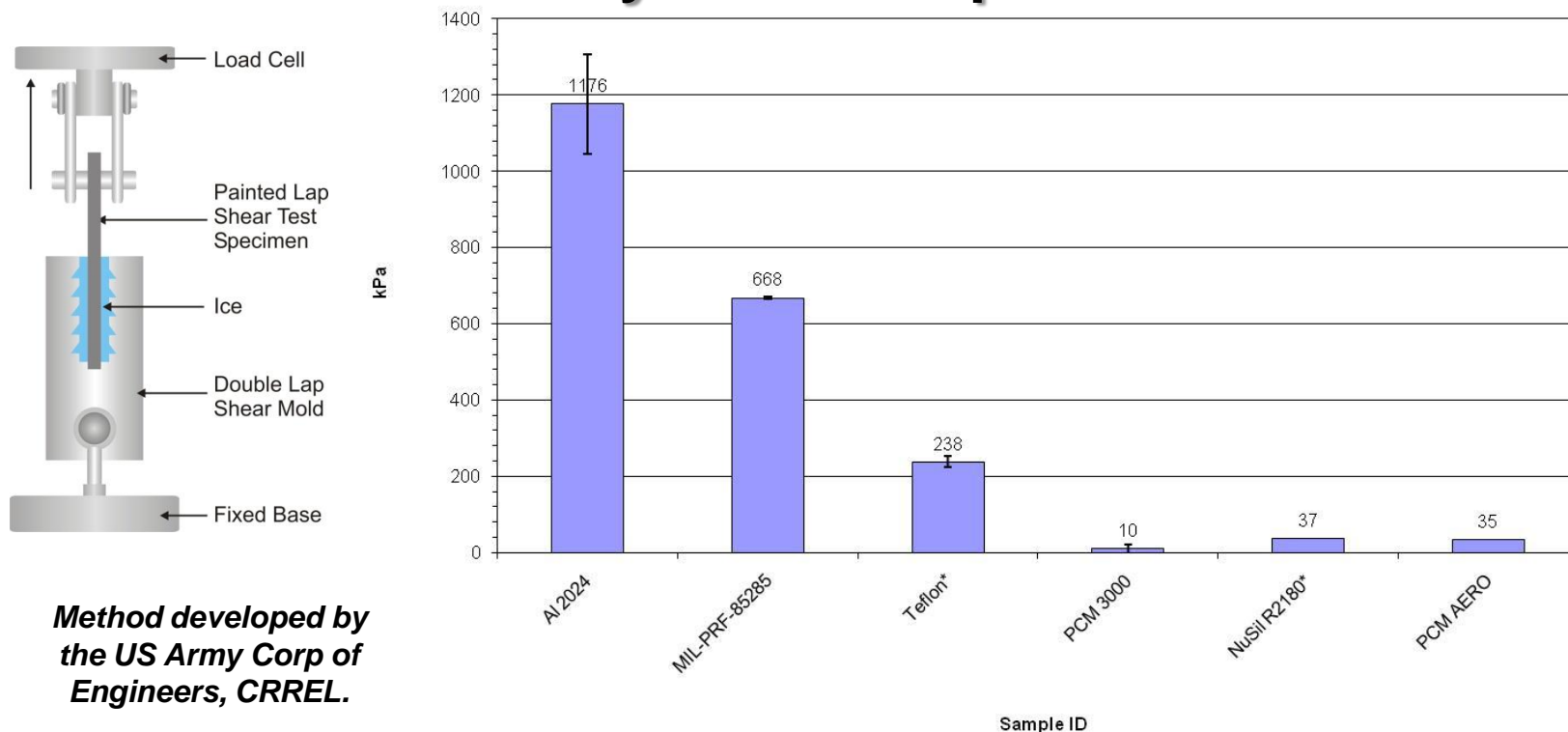
USAF POC: Dr. Elizabeth S. Berman



Ice-phobic Clearcoat to Improve Aircraft and Pilot Safety



Minimal Ice Adhesion to PCM Coating Technology Determined by Double Lap Shear Test



Method developed by the US Army Corp of Engineers, CRREL.

****Laboratory Ice Adhesion Test Results for Commercial Ice-phobic Coatings for Pratt & Whitney, May 2004, CRREL.***



Environmentally Benign Aircraft Anti-Icing and Deicing Fluids Based on Cost-Effective, Bio-Based Ingredients



- Partnership with Battelle Memorial Institute (lead agency), AFRL/ ASC, Army (CRREL), Navy (NAVAIR), Octagon, AMIL (University of Quebec)
- Maximize use of bio-based ingredients
 - Typically less persistent in environment, less corrosive, and less toxic
 - Reduction in carbon footprint based primarily on replacing petroleum-based PG as FPD
 - Battelle patents and experience with use of bio-based polyols along with other polyols, as needed, for freezing point depression
- Use of superior, multi-functional additives
 - Minimizes the number of additives and therefore corrosivity and toxicity
 - Simplifies overall formulation chemistry
 - Reduces manufacturing costs



Environmentally Advantaged Aircraft Deicing Fluid Demonstration



- **Field demonstration of environmentally advantaged aircraft deicing fluid (ADF), “EcoFlo II”**
 - **Winter of 2011-2012**
 - **Deice KC-135 aircraft, fly mission, observe aircraft**
 - **Observe aircraft surface for ADF properties, such as slipperiness, fish eyes, foaming, etc.**
- **Evaluate environmental properties**
 - **Non-toxic additives**
 - **Low chemical oxygen demand (COD), biochemical oxygen demand (BOD) compared to currently used ADFs**



Environmentally Advantaged Aircraft Deicing Fluid Demonstration



- **Material compatibility testing beyond SAE AMS 1424J Type I deicing fluid requirements**
 - **Military Test Method Standard, included in draft DoD Deicing Joint Test Protocol**
 - **Tested for compatibility with a cross section of military specific materials:**
 - **Metallics**
 - **Polymer Matrix Composites**
 - **Elastomerics**
 - **Aircraft Wire Insulation**
 - **Carbon/Carbon Brakes**
 - **Infrared Windows**

